USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2002KY2B

Title: Environmentally-induced genes and mechanisms of inheritance: How are the effects of contaminant exposure transferred from one generation to the next?

Project Type: Research

Focus Categories: Toxic Substances, Water Quality, Surface Water

Keywords: endocrine disruptors, fish, teleosts

Start Date: 03/01/2002

End Date: 02/28/2003

Federal Funds Requested: $13,600

Non-Federal Matching Funds Requested: $27,412

Congressional District: Sixth Kentucky

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Abstract

The pituitary hormones, prolactin (PRL) and growth hormone (GH) are unequivocally involved in vertebrate development and the normal function of tissues and organs. Sex steroids, such as estrogen, control the development of the pituitary gland, its gene expression and hormone release; however, the neuroendocrine system is further influenced by external factors such as stress, diet, physiological state, and pollutants which have been found to possess biological actions similar to that of estrogen (xenoestrogens). The idea that a single hormone (e.g., PRL) can regulate multiple physiological pathways, suggests that disturbances in its regulation may negatively impact these pathways in an adult vertebrate, and thus contribute to heritable, latent effects on offspring phenotype [1]. In support of this, recent work shows that Kentucky women living in areas of medium to high levels of an endocrine disrupting herbicide had a higher risk of breast cancer [2] with, perhaps, the attendant potential for latent effects in offspring development [1]. Therefore, we propose that contaminant exposure will not only affect pituitary physiology of the exposed organism, but will also influence the exposed organism's offspring through, as yet, poorly understood mechanisms. In this vein, scientists are increasingly using teleosts to study the effects of pollutants on vertebrate endocrinology as they are sensitive to these chemicals and encounter them routinely and chronically in their environment. Paradoxically, however, some studies indicate that certain teleosts appear to be "resistant" to contaminants and that this "resistance" is carried through the F1 and F2 generations [3]. Although the mechanism for such inherited phenotype(s) is unknown, it is thought that such adaptive responses come at the expense of favorable physiological characteristics such as long life-span, good immune function and high fecundity. Interestingly, however, recent reports suggest the presence of maternal mRNAs (hormone and hormone receptor mRNAs) in the unfertilized eggs of fish and this finding strongly suggests the involvement of these mRNAs in early embryonic development [4, 5], however, the significance and regulation of maternally-derived mRNAs have not been explored. Therefore, using molecular techniques, we aim to study how a prevalent, estrogenic pollutant (a hydroxylated PCB) alters maternal endocrine profiles and how such alterations affect maternally-derived mRNAs in the unfertilized eggs of the Yellow Perch (Perca flavescens).